Notice No.1

Rules and Regulations for the Construction and Classification of Ships for the Carriage of Liquefied Gases in Bulk, July 2016

The status of this Rule set is amended as shown and is now to be read in conjunction with this and prior Notices. Any corrigenda included in the Notice are effective immediately.

Issue date: December 2016

Amendments to	Effective date	Mandatory Instrument
Chapter 2, Section 2	1 January 2017	X
Chapter 3, Section 3	1 January 2017	X
Chapter 4, Section 4	1 January 2017	X
Chapter 5, Section 5	1 January 2017	X
Chapter 16, Section 16	1 January 2017	X

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Chapter 2
Ship Survival Capability and Location of Cargo Tanks

2.7 Survival requirements

2.7.2 At final equilibrium after flooding:

.1 the righting lever curve shall have a minimum range of 20° beyond the position of equilibrium in association with a maximum residual righting lever of at least 0.1 m within the 20° range; the area under the curve within this range shall not be less than 0.0175 m-radians. The 20° range may be measured from any angle commencing between the position of equilibrium and the angle of 25° (or 30° if no deck immersion occurs). Unprotected openings shall not be immersed within this range unless the space concerned is assumed to be flooded. Within this range, the immersion of any of the openings listed in 2.7.1.1 and other openings capable of being closed weathertight may be permitted; and

LR 2.7-01 Other openings capable of being closed weathertight, as detailed in 2.7.2.1 of the Code do not include ventilators (complying with ILLC 19(4)) that for operational reasons have to remain open to supply air to the engine room or emergency generator room (if the same is considered buoyant in the stability calculation or protecting openings leading below) for the effective operation of the ship.

.2 the emergency source of power shall be capable of operating.

LR 2.7-02 The requirement of LR 2.7-01 is to be applied unless specified otherwise by the National Administration.

Chapter 3
Ship Arrangements

3.2 Accommodation, service and machinery spaces and control stations

3.2.6 All air intakes, outlets and other openings into the accommodation spaces, service spaces and control stations shall be fitted with closing devices. When carrying toxic products, they shall be capable of being operated from inside the space. The requirement for fitting air intakes and openings with closing devices operated from inside the space for toxic products need not apply to spaces not normally manned, such as deck stores, forecastle stores, workshops. In addition, the requirement does not apply to cargo control rooms located within the cargo area.

~~**LR 3.2-02** The closing devices should give a reasonable degree of gas tightness. Ordinary steel fire-flaps without gaskets/seals should normally not be considered satisfactory. Attention should also be made to IACS Unified Interpretation GC5.~~

LR 3.2-02 The closing devices detailed in 3.2.6 of the Code need not be operable from within the single spaces listed but may be located in centralised positions. The requirement for closing devices need not apply to the following spaces:

- engine room casings;
- cargo machinery spaces;
- electric motor rooms; and
- steering gear compartments.

LR 3.2-03 The closing devices detailed in 3.2.6 of the Code are to give a reasonable degree of gas tightness. Ordinary steel fire-flaps without gaskets/seals are not considered to be satisfactory.

LR 3.2-04 The requirements of LR 3.2-02 to LR 3.2-03 are to be applied unless specified otherwise by the National Administration.

3.5 Access to spaces in the cargo area

3.5.3 Arrangements for hold spaces, void spaces, cargo tanks and other spaces classified as hazardous areas, shall be such as to allow entry and inspection of any such space by personnel wearing protective clothing and breathing apparatus and shall also allow for the evacuation of injured and/or unconscious personnel. Such arrangements shall comply with the following:

.1 Access shall be provided as follows:

.1 access to all cargo tanks. Access shall be direct from the weather deck;

.2 access through horizontal openings, hatches or manholes. The dimensions shall be sufficient to allow a person wearing a breathing apparatus to ascend or descend any ladder without obstruction and also to provide a clear opening to facilitate the hoisting of an injured person from the bottom of the space. The minimum clear opening shall be not less than 600 mm x 600 mm;

LR 3.5-01 The minimum clear opening detailed in 3.5.3.1.2 of Code, of 600 mm x 600 mm may have corner radii up to 100 mm maximum. If, as a consequence of structural analysis of a given design, the stress is to be reduced around the opening, it is considered

appropriate to take measures to reduce the stress by making the opening larger with increased radii, e.g. 600 x 800 with 300 mm radii, within which a clear opening of 600 mm x 600 mm with corner radii up to 100 mm maximum can fit.

.3 access through vertical openings or manholes providing passage through the length and breadth of the space. The minimum clear opening shall be not less than 600 mm x 800 mm at a height of not more than 600 mm from the bottom plating unless gratings or other footholds are provided; and

LR 3.5-02 The minimum clear opening detailed in 3.5.3.1.3 of Code, of not less than 600 mm x 800 mm may have corner radii up to 300 mm, *see Figure LR 3.1 Vertical Openings*. An opening of 600 mm in height x 800 mm in width may be accepted as access openings in vertical structures where it is not desirable to make large vertical openings in structural members such as girders and floors in double bottom tanks.

LR 3.5-03 Subject to verification of easy evacuation of an injured person on a stretcher a vertical opening with maximum dimensions of 850 mm x 620 mm is considered an acceptable alternative, where the upper half is wider than 600 mm, and where the lower half is less than 600 mm, *see Figure LR 3.2 Alternative Vertical Openings*.

LR 3.5-04 If the bottom of a vertical opening is at a height of more than 600 mm above the deck, steps and handgrips are to be provided. In such arrangements it is to be demonstrated that an injured person can be easily evacuated.

.4 circular access openings to type C tanks shall have a diameter of not less than 600 mm.

.2 The dimensions referred to in 3.5.3.1.2 and 3.5.3.1.3 may be decreased, if the requirements of 3.5.3 can be met to the satisfaction of the Administration.

.3 Where cargo is carried in a containment system requiring a secondary barrier, the requirements of 3.5.3.1.2 and 3.5.3.1.3 do not apply to spaces separated from a hold space by a single gastight steel boundary. Such spaces shall be provided only with direct or indirect access from the weather deck, not including any enclosed non-hazardous area.

.4 Access required for inspection shall be a designated access through structures below and above cargo tanks, which shall have at least the cross-sections as required by 3.5.3.1.3.

.5 For the purpose of 3.5.1 or 3.5.2, the following shall apply:

.1 where it is required to pass between the surface to be inspected, flat or curved, and structures such as deck beams, stiffeners, frames, girders, etc., the distance between that surface and the free edge of the structural elements shall be at least 380 mm. The distance between the surface to be inspected and the surface to which the above structural elements are fitted, e.g. deck, bulkhead or shell, shall be at least 450 mm for a curved tank surface (e.g. for a type C tank), or 600 mm for a flat tank surface (e.g. for a type A tank) (see figure 3.1);

.2 where it is not required to pass between the surface to be inspected and any part of the structure, for visibility reasons the distance between the free edge of that structural element and the surface to be inspected shall be at least 50 mm or half the breadth of the structure's face plate, whichever is the larger (see figure 3.2);

.3 if for inspection of a curved surface where it is required to pass between that surface and another surface, flat or curved, to which no structural elements are fitted, the distance between both surfaces shall be at least 380 mm (see figure 3.3). Where it is not required to pass between that curved surface and another surface, a smaller distance than 380 mm may be accepted taking into account the shape of the curved surface;

.4 if for inspection of an approximately flat surface where it is required to pass between two approximately flat and approximately parallel surfaces, to which no structural elements are fitted, the distance between those surfaces shall be at least 600 mm. Where fixed access ladders are fitted, a clearance of at least 450 mm shall be provided for access (see figure 3.4);

.5 the minimum distances between a cargo tank sump and adjacent double bottom structure in way of a suction well shall not be less than those shown in figure 3.5 (figure 3.5 shows that the distance between the plane surfaces of the sump and the well is a minimum of 150 mm and that the clearance between the edge between the inner bottom plate, and the vertical side of the well and the knuckle point between the spherical or circular surface and sump of the tank is at least 380 mm). If there is no suction well, the distance between the cargo tank sump and the inner bottom shall not be less than 50 mm;

.6 the distance between a cargo tank dome and deck structures shall not be less than 150 mm (see figure 3.6);

.7 fixed or portable staging shall be installed as necessary for inspection of cargo tanks, cargo tank supports and restraints (e.g. anti-pitching, anti-rolling and anti-flotation chocks), cargo tank insulation etc. This staging shall not impair the clearances specified in 3.5.3.5.1 to 3.5.3.5.4; and

.8 if fixed or portable ventilation ducting shall be fitted in compliance with 12.1.2, such ducting shall not impair the distances required under 3.5.3.5.1 to 3.5.3.5.4.

~~**LR 3.5-01** Notwithstanding 3.5.3.3, the requirements for minimum clear openings given in 3.5.3.1.2 and 3.5.3.1.3 are to be adhered to for spaces defined in 1.2.24.5.~~

LR 3.5-05 The requirements of LR 3.5-01 to LR 3.5-04 are to be applied unless specified otherwise by the National Administration.

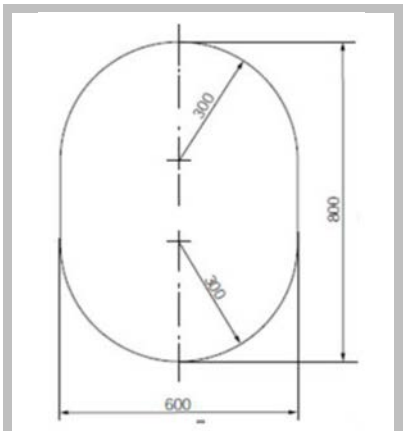

Figure LR 3.1 Vertical Openings

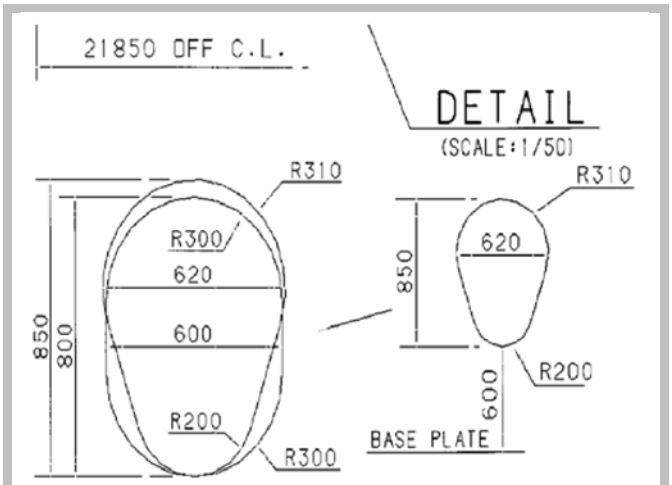

Figure LR 3.2 Alternative Vertical Openings

The existing requirement of LR 3.5-02 *has been renumbered* LR 3.5-06.

3.7 Bilge, ballast and oil fuel arrangements

3.7.5 Ballast spaces, including wet duct keels used as ballast piping, oil fuel tanks and non-hazardous spaces, may be connected to pumps in the machinery spaces. Dry duct keels with ballast piping passing through may be connected to pumps in the machinery spaces, provided the connections are led directly to the pumps, and the discharge from the pumps is led directly overboard with no valves or manifolds in either line that could connect the line from the duct keel to lines serving non-hazardous spaces. Pump vents shall not be open to machinery spaces.

LR 3.7-01 Unless specified otherwise, the requirement within 3.7.5 of the Code for Pump vents not to be open to machinery spaces need only be applied to pumps in machinery spaces serving dry duct keels through which ballast piping passes.

LR 3.7-02 The requirement of LR 3.7-01 is to be applied unless specified otherwise by the National Administration.

Chapter 4
Cargo Containment

4.6 Design of secondary barriers

4.6.2 The design of the secondary barrier shall be such that:

.1 it is capable of containing any envisaged leakage of liquid cargo for a period of 15 days, unless different criteria apply for particular voyages, taking into account the load spectrum referred to in 4.18.2.6;

.2 physical, mechanical, or operational events within the cargo tank that could cause failure of the primary barrier shall not impair the due function of the secondary barrier, or vice versa;

.3 failure of a support or an attachment to the hull structure will not lead to loss of liquid tightness of both the primary and secondary barriers;

.4 it is capable of being periodically checked for its effectiveness by means acceptable to the Administration or recognized organization acting on its behalf. This may be by means of a visual inspection or a pressure/vacuum test or other suitable means carried out according to a documented procedure agreed with the Administration or the recognized organization acting on its behalf;

LR 4.6-01 For containment systems with glued secondary barriers the following factors are to be taken into account:
(a) At the time of construction, a tightness test is to be carried out in accordance with approved system designers' procedures and acceptance criteria before and after initial cool down. Low differential pressures tests are not considered an acceptable test.
(b) If the designer's threshold values are exceeded, an investigation is to be carried out and additional testing such as thermographic or acoustic emissions testing should be carried out.
(c) The values recorded are to be used as reference for future assessment of secondary barrier tightness.

For containment systems with welded metallic secondary barriers, a tightness test after initial cool down is not required.

LR 4.6-02 The requirement of LR 4.6-01 is to be applied unless specified otherwise by the National Administration.

.5 the methods required in .4 above shall be approved by the Administration or recognized organization acting on its behalf and shall include, where applicable to the test procedure:

.1 details on the size of defect acceptable and the location within the secondary barrier, before its liquid-tight effectiveness is compromised;

.2 accuracy and range of values of the proposed method for detecting defects in .1 above;

.3 scaling factors to be used in determining the acceptance criteria, if full scale model testing is not undertaken; and

.4 effects of thermal and mechanical cyclic loading on the effectiveness of the proposed test; and

.6 the secondary barrier shall fulfil its functional requirements at a static angle of heel of 30°.

4.23 Type C independent tanks

4.23.1 ***Design basis***

4.23.1.2 The design vapour pressure shall not be less than:

P_o = $0.2 + AC(\rho_r)^{1.5}$ (MPa)

where:

$$A = 0.00185\left(\frac{\sigma_m}{\Delta\sigma_A}\right)^2$$

with:

σ_m = design primary membrane stress;

$\Delta\sigma_A$ = allowable dynamic membrane stress (double amplitude at probability level Q = 10^{-8}) and equal to:
- 55 N/mm^2 for ferritic-perlitic, martensitic and austenitic steel;
- 25 N/mm^2 for aluminium alloy (5083-O);

C = a characteristic tank dimension to be taken as the greatest of the following:
h, 0.75b or 0.45ℓ,
with:

h = height of tank (dimension in ship's vertical direction) (m);

b = width of tank (dimension in ship's transverse direction) (m);

ℓ = length of tank (dimension in ship's longitudinal direction) (m);

ρ_r = the relative density of the cargo (ρ_r = 1 for fresh water) at the design temperature.

When a specified design life of the tank is longer than 10^8 wave encounters, $\Delta\sigma_A$ shall be modified to give equivalent crack propagation corresponding to the design life.

LR 4.23-01 If the carriage of products not covered by the Code is intended, it is to be verified that the double amplitude of the primary membrane stress, $\Delta\sigma_m$ created by the maximum dynamic pressure differential ΔP does not exceed the allowable double amplitude of the dynamic membrane stress, $\Delta\sigma_A$ as specified in paragraph 4.23.1.2 of the Code:
$\Delta\sigma_m \leq \Delta\sigma_A$

The maximum dynamic pressure differential ΔP is to be calculated as follows:

$$\Delta P = \frac{\rho}{1.02\times10^5}\left(\alpha_{\beta1}Z_{\beta1} - \alpha_{\beta2}Z_{\beta2}\right) \qquad \text{(MPa)}$$

where
ρ is maximum liquid cargo density in kg/m^3 at the design temperature
α_β, Z_β are as defined in 4.28.1.2 of the Code, *see also Figure LR 4.3 Maximum dynamic pressure differential*
$\alpha_{\beta1}$, $Z_{\beta1}$ are the α_β and Z_β values giving the maximum liquid pressure $(P_{gd})_{max}$
$\alpha_{\beta2}$, $Z_{\beta2}$ are the α_β and Z_β values giving the minimum liquid pressure $(P_{gd})_{min}$

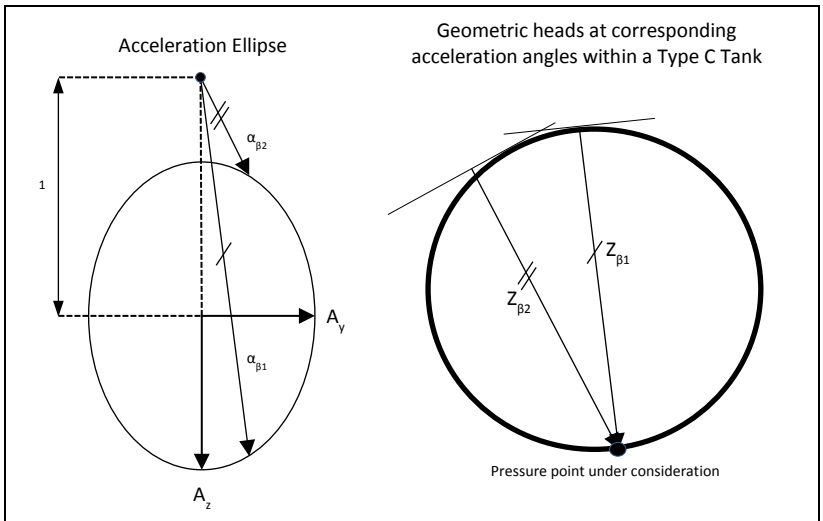

Figure LR 4.3 Maximum dynamic pressure differential

LR 4.23-02 The requirement of LR 4.23-01 is to be applied unless specified otherwise by the National Administration.

The existing requirements of LR 4.23-01 *to* LR 4.23-04 *have been renumbered* LR 4.23-03 *to* LR 4.23-06.

4.23.3 ***Ultimate design condition***

4.23.3.1 Plastic deformation

For type C independent tanks, the allowable stresses shall not exceed:

σ_m	$\leq f$
σ_L	$\leq 1.5f$
σ_b	$\leq 1.5f$
$\sigma_L+\sigma_b$	$\leq 1.5f$
$\sigma_m+\sigma_b$	$\leq 1.5f$
$\sigma_m+\sigma_b+\sigma_g$	$\leq 3.0f$
$\sigma_L+\sigma_b+\sigma_g$	$\leq 3.0f$,

where:

σ_m = equivalent primary general membrane stress;
σ_L = equivalent primary local membrane stress;
σ_b = equivalent primary bending stress;
σ_g = equivalent secondary stress; and
f = the lesser of R_m/A or R_e/B,

with R_m and R_e as defined in 4.18.1.3. With regard to the stresses σ_m, σ_L, σ_b *and* σ_g, the definition of stress categories in 4.28.3 are referred. The values A and B shall be shown on the International Certificate of Fitness for the Carriage of Liquefied Gases in Bulk and shall have at least the following minimum values:

	Nickel steels and carbon-manganese steels	**Austenitic steels**	**Aluminium alloys**
A	3	3.5	4
B	1.5	1.5	1.5

LR 4.23-07 The circumferential stresses at supports of Type C tanks, are to be calculated by a procedure acceptable to LR for an agreed number of load cases.

LR 4.23-08 For stiffening rings of Type C tanks, the equivalent stress is to be calculated over the full extent of the stiffening ring by a procedure acceptable to LR, for an agreed number of load cases. For horizontal cylindrical tanks made of C-Mn steel supported in saddles, the equivalent stress in the stiffener rings is not to exceed the following values where calculated using finite element analysis:
$\sigma_e \leq \sigma_{all}$
where
σ_{all} = the lesser of $0{,}57R_m$ or $0{,}85R_e$
$\sigma_e = \sqrt{(\sigma_n + \sigma_b)^2 + 3\tau^2}$
σ_e = von Mises equivalent stress in N/mm^2
σ_n = normal stress in N/mm^2 in the circumferential direction of the stiffening ring
σ_b = bending stress in N/mm^2 in the circumferential direction of the stiffening ring
τ = shear stress in N/mm^2 in the stiffening ring
R_m and R_e as defined in 4.18.1.3 of the Code.

LR 4.23-09 The following assumptions are to be made for the stiffening rings:
(a) The stiffening ring is to be considered as a circumferential beam formed by web, face plate, doubler plate, if any, and associated shell plating.
(b) For cylindrical shells the effective width of the associated plating is to be taken as not greater than $0{,}78\sqrt{rt}$ on each side of the web. A doubler plate, if any, may be included within that distance.
where
r = mean radius of the cylindrical shell (mm)
t = shell thickness (mm)
(c) For longitudinal bulkheads (in the case of lobe tanks) the effective width is to be specially considered. A value of $20t_b$ on each side of the web may be taken as a guidance value.
where
t_b = bulkhead thickness (mm).
(d) The stiffening ring should be loaded with circumferential forces, on each side of the ring, due to the shear stress, determined by the bi-dimensional shear flow theory from the shear force of the tank.

LR 4.23-10 The buckling strength of the stiffening rings, of Type C tanks is to be examined.

LR 4.23-11 For the calculation of reaction forces at the supports of Type C tanks, the following factors are to be taken into account:
(a) Elasticity of support material (intermediate layer of wood or similar material).
(b) Change in contact surface between tank and support, and of the relevant reactions, due to thermal shrinkage of tank or elastic deformations of tank and support material.
The final distribution of the reaction forces at the supports should not show any tensile forces.

LR 4.23-12 The requirements of LR 4.23-07 to LR 4.23-11 are to be applied unless specified otherwise by the National Administration.

The existing requirements of LR 4.23-05 *have been renumbered* LR 4.23-13.

Chapter 5
Process Pressure Vessels and Liquid, Vapour and Pressure Piping Systems

5.13 Testing requirements

5.13.1 *Type testing of piping components*

5.13.1.1 Valves[12]

LR 5.13-03 All valves are to be tested at the manufacturer's works to the satisfaction of the LR Surveyor. Testing is to include a hydrostatic test of the valve body at a pressure equal to 1,5 times the design pressure for all valves, and a seat and stem leakage test at a pressure equal to 1,1 times the design pressure for valves other than safety valves. In addition, cryogenic testing consisting of

valve operation and leakage verification for a minimum of 10 per cent of each type and size of valve for valves other than safety valves intended to be used at a working temperature below –55°C. The set pressure of safety valves is to be tested at ambient temperature.

Notwithstanding the above, unit production testing need not be witnessed by the LR Surveyor for valves which are employed for the purposes of the isolation of instrumentation in piping which is not greater than 25 mm nominal diameter. Records of testing are to be made available for review.

Alternatively, if so requested by the relevant manufacturer, the certification of a valve may be issued subject to the following:

(a) the valve has been approved as required by LR 5.13-01 for valves intended to be used at a working temperature below –55°C; and

(b) the manufacturer has a recognised quality system that has been assessed and certified by LR in accordance with the requirements of Pt 5, Ch 1,6 of the Rules for Ships; and

(c) a quality control plan is submitted which contains a provision to subject each valve to a hydrostatic test of the valve body at a pressure equal to 1,5 times the design pressure for all valves and seat and stem leakage test at a pressure equal to 1,1 times the design pressure for valves other than safety valves. The set pressure of safety valves is to be tested at ambient temperature. The manufacturer is to maintain records of such tests; and

(d) cryogenic testing consisting of valve operation and leakage verification for a minimum of 10 per cent of each type and size of valve for valves other than safety valves intended to be used at a working temperature below –55°C to the satisfaction of the LR Surveyor.

Chapter 16
Use of Cargo as Fuel

16.7 Special requirements for gas-fired internal combustion engines

16.7.3 ***Safety***

LR 16.7–05 ~~The crankcase is to be fitted with gas detecting, or equivalent equipment, and~~ Where trunk piston type engines are used, a means ~~for the injection~~ of injecting inert gas into the crankcase is to be provided. ~~The inert gas injection is to be capable of remote operation from a safe location. Crankcase relief valves are also to be fitted as required by Pt 5, Ch 2,10 of the Rules for Ships.~~

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